

CLAIMS

1. A dye-sensitized solar cell module comprising at least two photoelectric conversion elements each comprising a transparent conductive layer, a porous photoelectric conversion layer adsorbing a dye, 5 an electrolytic layer, a catalyst layer, and a conductive layer on a transparent substrate, wherein the respective photoelectric conversion elements are different in at least one among the layering order of the respective layers composing the photoelectric conversion elements; the type and composition of the materials for the respective layers; the 10 particle diameter on the case the materials of the respective layers are granular; the thickness and width of the respective layers; the form of the respective layers; and the open circuit voltage of the photoelectric conversion elements.
- 15 2. The dye-sensitized solar cell module according to claim 1 comprising first photoelectric conversion elements each comprising a transparent conductive layer, a porous photoelectric conversion layer adsorbing a dye, an electrolytic layer, a catalyst layer, and a conductive layer from the transparent substrate side; second photoelectric 20 conversion elements each comprising a transparent conductive layer, a catalyst layer, an electrolytic layer, a porous photoelectric conversion layer adsorbing a dye, and a conductive layer from the transparent substrate side; a supporting substrate formed on the respective conductive layers of the first and second photoelectric conversion 25 elements, wherein one or more first photoelectric conversion elements and one or more second photoelectric conversion elements are alternately arranged in parallel between the transparent substrate and the supporting substrate and at least the first photoelectric conversion elements and the second photoelectric conversion elements are different 30 from each other.
3. The dye-sensitized solar cell module according to claim 2,

wherein the neighboring first photoelectric conversion elements and second photoelectric conversion elements are electrically connected in series.

5 4. The dye-sensitized solar cell module according to claim 2 or 3, wherein the first photoelectric conversion elements and the second photoelectric conversion elements are different in at least one among the composition of the electrolytic layers; the thickness of the porous photoelectric conversion layers; the width of the photoelectric conversion 10 layers; the dye to be adsorbed in the photoelectric conversion layers; the average particle diameter of the semiconductor particles composing the porous photoelectric conversion layers; and the form of the catalyst layers.

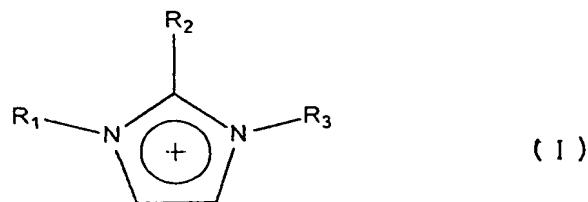
15 5. The dye-sensitized solar cell module according to claim 4, wherein the first photoelectric conversion elements and the second photoelectric conversion elements contain iodine in the respective electrolytic layers and the iodine concentration in the electrolytic layers of the second photoelectric conversion elements is lower than the iodine 20 concentration in the electrolytic layers of the first photoelectric conversion elements.

6. The dye-sensitized solar cell module according to claim 5, wherein the ratio $M1/M2$ of the iodine concentration $M1$ in the electrolytic layers of the first photoelectric conversion elements and the iodine concentration $M2$ in the electrolytic layers of the second photoelectric conversion elements is higher than 1 and not higher than 5.

30 7. The dye-sensitized solar cell module according to any one of claims 2 to 6, wherein the electrolytic layers of the respective elements or the electrolytic layer of at least one element among one or more of the first photoelectric conversion elements and one or more of the second

photoelectric conversion elements contains at least one of imidazole and imidazolium salts.

8. The dye-sensitized solar cell module according to claim 7,
5 wherein the imidazolium salts are salts of compounds defined by the
following formula (I):



wherein R₁ and R₂ independently denote a hydrogen atom or methyl; R₃
10 denotes methyl, ethyl, propyl, butyl, or hexyl.

9. The dye-sensitized solar cell module according to claim 7 or 8,
wherein the imidazolium salts contained in the respective electrolytic
layers of the first photoelectric conversion elements and the second
15 photoelectric conversion elements differ.

10. The dye-sensitized solar cell module according to any one of
claims 2 to 9, wherein at least one element among one or more of the first
photoelectric conversion elements and one or more of the second
20 photoelectric conversion elements contains lithium iodide in the
electrolytic layer thereof.

11. The dye-sensitized solar cell module according to any one of
claims 3 to 12, wherein the thicknesses of the porous photoelectric
conversion layers of the first photoelectric conversion elements and the
25 second photoelectric conversion elements differ.

12. The dye-sensitized solar cell module according to any one of

claims 2 to 11, wherein the thicknesses of the porous photoelectric conversion layers of the first photoelectric conversion elements are thinner than the thicknesses of the porous photoelectric conversion layers of the second photoelectric conversion elements.

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13. The dye-sensitized solar cell module according to any one of claims 2 to 12, wherein the short circuit current density of the first photoelectric conversion elements is defined as J_d and the short circuit current density of the second photoelectric conversion elements is defined as J_c , $(J_c/J_d) > 0.7$ is satisfied.

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14. The dye-sensitized solar cell module according to any one of claims 2 to 13, wherein the light receiving surface areas of the respective porous photoelectric conversion layers of the first photoelectric conversion elements and the second photoelectric conversion elements differ.

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15. The dye-sensitized solar cell module according to claim 14, wherein the light receiving surface areas of the respective porous photoelectric conversion layers of the second photoelectric conversion elements are larger than the light receiving surface areas of the respective porous photoelectric conversion layers of the first photoelectric conversion elements.

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16. The dye-sensitized solar cell module according to 14 or 15, wherein the widths of the respective porous photoelectric conversion layers of the first photoelectric conversion elements and the second photoelectric conversion elements differ in the series connection direction of the solar cells.

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17. The dye-sensitized solar cell module according to any one of claims 14 to 16, wherein the light receiving surface areas of the respective

porous photoelectric conversion layers of a plurality of the first photoelectric conversion elements are the same and the light receiving surface areas of the respective porous photoelectric conversion layers of a plurality of the second photoelectric conversion elements are the same.

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18. The dye-sensitized solar cell module according to any one of claims 2 to 17, wherein a single dye is adsorbed in the respective porous photoelectric conversion layers of a plurality of the first photoelectric conversion elements and a single dye is adsorbed in the respective porous photoelectric conversion layers of a plurality of the second photoelectric conversion elements.

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19. The dye-sensitized solar cell module according to any one of claims 3 to 18, wherein open circuit voltage of the first photoelectric conversion elements and the second photoelectric conversion elements differ.

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20. The dye-sensitized solar cell module according to claim 19, wherein open circuit voltage values of the first photoelectric conversion elements are higher than open circuit voltage values of the second photoelectric conversion elements.

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21. The dye-sensitized solar cell module according to any one of claims 2 to 20, wherein the average particle diameter of the semiconductor particles of the porous semiconductor layers of the first photoelectric conversion elements is smaller than the average particle diameter of the semiconductor particles of the porous semiconductor layers of the second photoelectric conversion elements.

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30 22. The dye-sensitized solar cell module according to claim 21, wherein the porous semiconductor layer of at least each of the second photoelectric conversion elements is composed of a plurality of layers and

the average particle diameter of the semiconductor particles in the porous semiconductor layer closest to the supporting substrate is larger than the average particle diameter of the semiconductor particles in the porous semiconductor layer farthest from the supporting substrate.

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23. The dye-sensitized solar cell module according to claim 22, wherein the average particle diameter of the semiconductor particles of the porous semiconductor layers of the first photoelectric conversion elements is 30 nm or smaller and the semiconductor particles with a particle diameter of 100 nm or larger are contained in the porous semiconductor layers of the second photoelectric conversion elements.

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24. The dye-sensitized solar cell module according to claim 23, wherein the porous semiconductor layer of each of the second photoelectric conversion elements is composed of a plurality of layers and the semiconductor particles with a particle diameter of 100 nm or larger are contained in the porous semiconductor layer closest to the supporting substrate and the semiconductor particles with an average particle diameter of 30 nm or smaller are contained in the porous semiconductor layer farthest from the supporting substrate.

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26. The dye-sensitized solar cell module according to any one of claims 2 to 24, wherein the light transmittance of the catalyst layers of the second photoelectric conversion elements is lower than the light transmittance of the catalyst layers of the first photoelectric conversion elements since the shapes of the catalyst layers of the first photoelectric conversion elements and the catalyst layers of the second photoelectric conversion elements differ.

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26. The dye-sensitized solar cell module according to claim 25, wherein the catalyst layers of the second photoelectric conversion elements have aperture parts.

27. The dye-sensitized solar cell module according to claim 26, wherein the catalyst layers of the second photoelectric conversion elements have a lattice-like shape.

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28. The dye-sensitized solar cell module according to claim 26, wherein the catalyst layers of the second photoelectric conversion elements have a stripe shape.

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29. The dye-sensitized solar cell module according to claim 26, wherein the catalyst layers of the second photoelectric conversion elements have a dotted shape.

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30. The dye-sensitized solar cell module according to any one of claims 1 to 29, wherein the catalyst layers contain Pt.